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(54) Heat exchanger

(57) A method of producing a heat exchanger, comprises providing a corrugated sheet, forming the corrugations into passageways for fluid flow along the corrugations so that adjacent passageways have a common wall, providing a fluid inlet and a fluid outlet for the passageways, so that, in use, fluid flowing along each passageway is in heat-exchange communication through said common wall with fluid flowing along an adjacent passageway, the mouths of the recesses of the corrugated sheet being closed or partially so by a sheet (10, 11) of material continuous with the corrugated sheet.

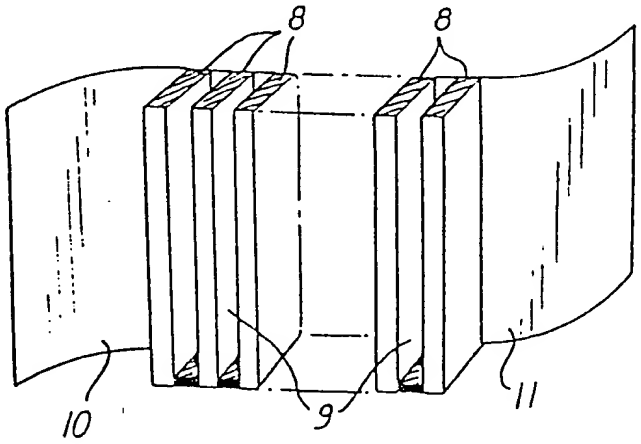

FIG.3

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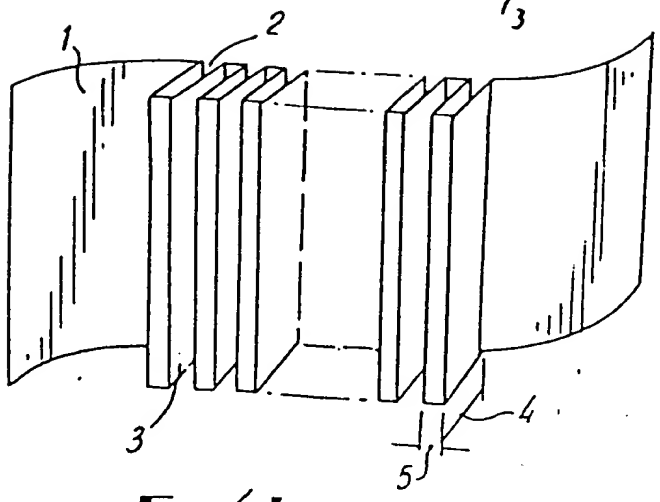

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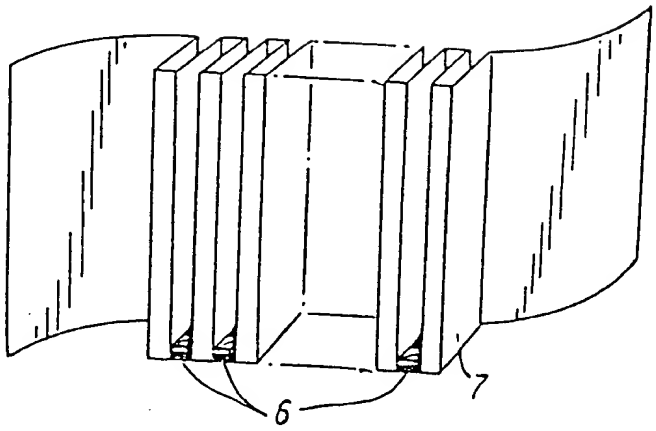

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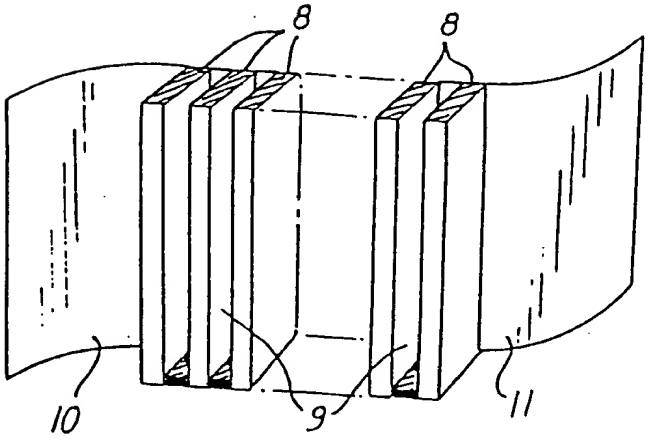

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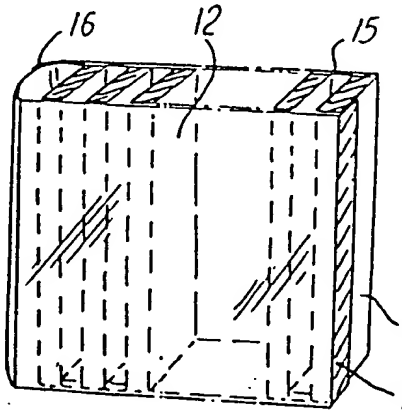

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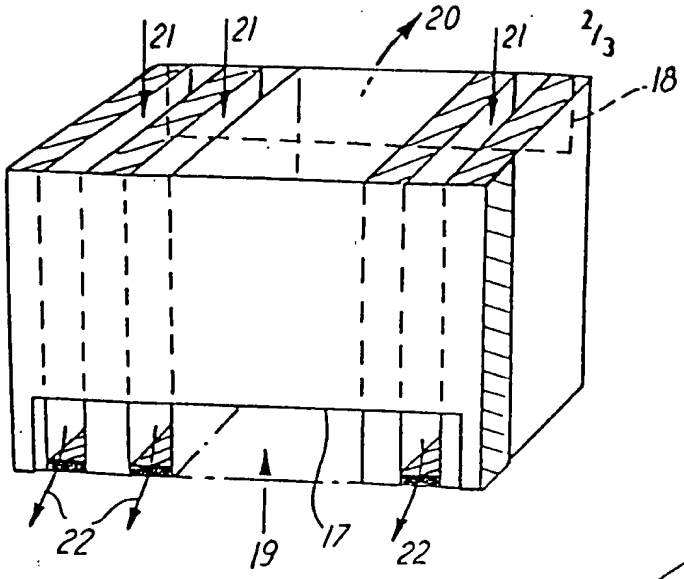

FIG. 5

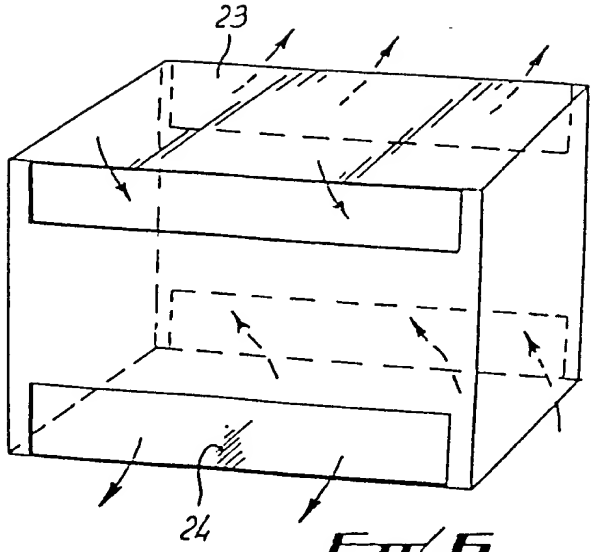

FIG. 6

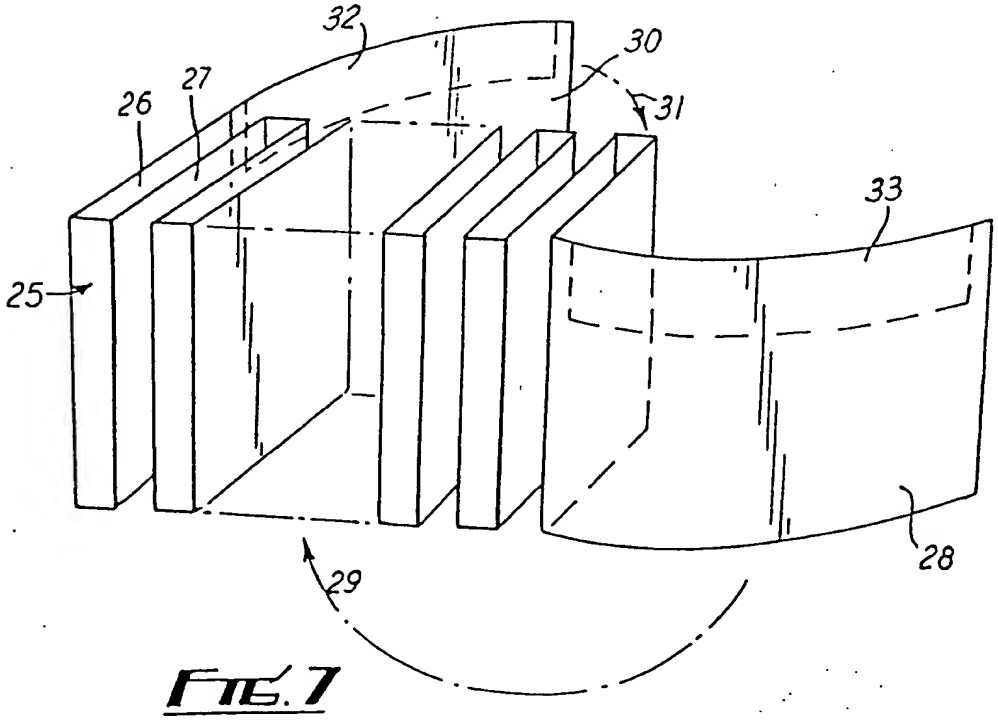

FIG. 7

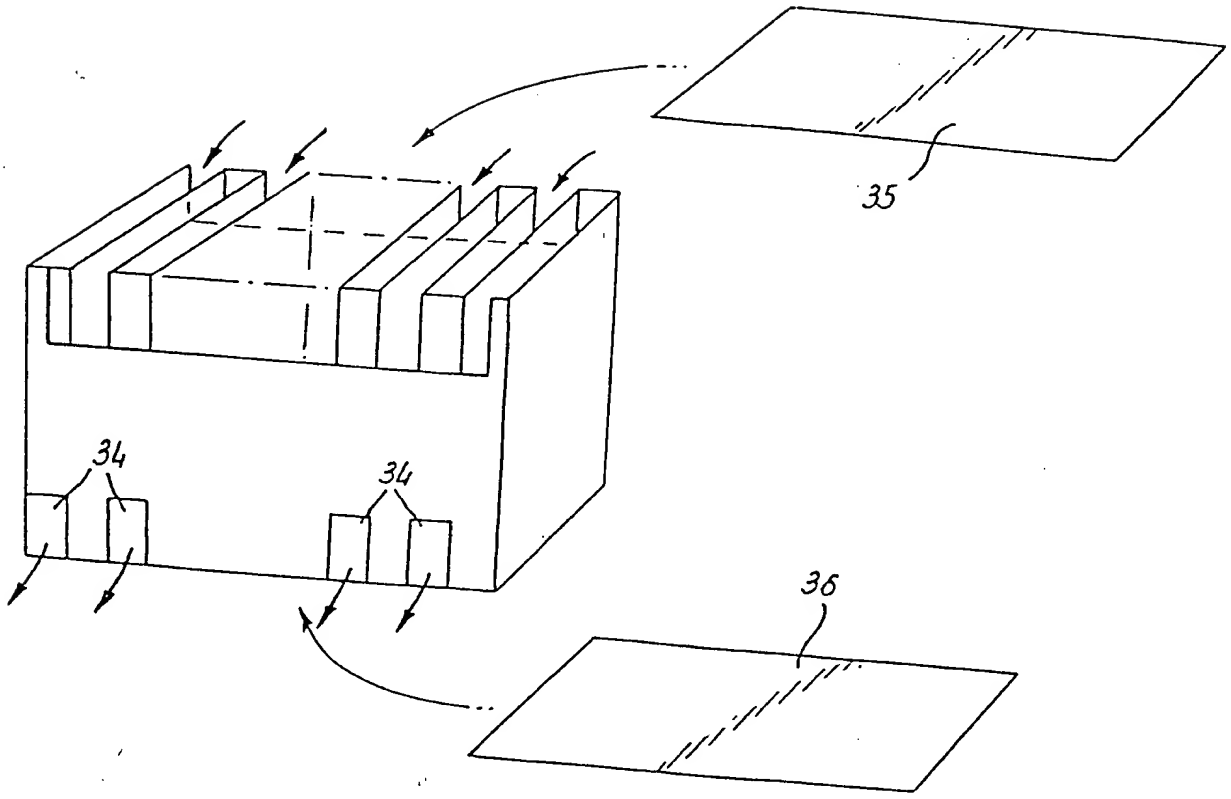

Fig.8

SPECIFICATION

Heat exchanger

This invention relates to the construction of a heat exchanger for transferring heat between two fluids without mixing of the two fluids during the heat transfer process.

Heat transfer from one fluid to another, while keeping the two fluids separate, is a common domestic and industrial process and many designs of heat exchangers are utilised. In many cases the design of heat exchanger is dictated by the types of fluids involved in the heat transfer, for example the finned tube heat exchanger used in a car radiator to transfer heat from the engine cooling water to air, or as used as a refrigeration condenser to transfer heat from a condensing refrigerant gas to air.

In general, the arrangement is such that one fluid passes along the side of one wall of a pipe or duct while the other fluid passes along the other side and heat transfer takes place between the fluids across the wall due to the temperature difference between the fluids. The size and type of the pipes carrying the fluids depends upon the types of fluids involved in the heat transfer, for example, the bundle of tubes carrying water in a large duct carrying the flue gases from a furnace.

The complexity of many designs of heat exchangers, and the need to ensure good sealing of the pipes or ducts to prevent mixing of the fluids, add to the cost of heat exchanger units.

According to the present invention there is provided a method of producing a heat exchanger, comprising providing a corrugated sheet, forming the corrugations into passageways for fluid flow along the corrugations so that adjacent passageways have a common wall, providing a fluid inlet and a fluid outlet for the passageways, so that, in use, fluid flowing along each passageway is in heat-exchange communication through said common wall with fluid flowing along an adjacent passageway.

The passageways may be formed by each recess of the corrugations being sealed at one end.

The mouths of said passageways may also be closed or partially so; preferably, said mouths are closed by the juxtaposition of a sheet of material continuous with the corrugated sheet.

Further according to the present invention there is provided a heat exchanger produced by the method of this invention.

Still further according to the present invention there is provided a domestic heating system incorporating a heat exchanger as described in the preceding paragraph, the heat exchanger being mounted on a hood situated above the external opening of a gas balanced flue such that flue gases at an elevated temperature rise from the flue to pass into one set of passageways of the heat exchanger for heat exchange with fresh air in another set of passageways of the heat exchanger, therafter the fresh air being expelled into the area being heated.

The sheet of material forming the heat exchanger may have a ribbed surface so as to increase the surface area available for heat transfer between adjacent passageways and also to produce turbulence in fluid flowing in the passageways.

The sheet of material may be either a single layer of material or it may consist of a sandwich of two or more materials.

The flows of gases may be fan assisted to increase the flow rates.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figures 1 to *5* are perspective views illustrating successive steps in the formation of one embodiment of a heat exchanger in accordance with the present invention;

Figure 6 is a perspective view of a second embodiment of a heat exchanger in accordance with the present invention; and

Figures 7 and *8* are perspective views illustrating successive steps in the formation of a third embodiment of a heat exchanger in accordance with the present invention.

Referring to the drawings, Figure 1 shows a long continuous impervious sheet of aluminium foil 1 which has been corrugated into a large number of rectangular sided sections of alternating large and small width indicated by the widths of the sections 4 and 5 respectively. In this way, ducts are formed on either side of the sheet illustrated by duct 2 on the back face of sheet 1 and duct 3 on the front face of sheet 1 in Figure 1.

Figure 2 shows all of the ducts on the front face of the sheet closed off at the bottom by a sealant consisting of a silicone rubber cold curing liquid poured into the ducts from the front face only 6. The hidden ducts 7 at the base in Figure 2 are all still open out of the base of the heat exchanger.

Figure 3 shows the ducts at the back of the sheet similarly closed off at the top of each duct by a silicone rubber composition. The ducts 9 at the front of the sheet remain open at the top of the heat exchanger.

Figure 4 shows the loose end 10 (Figure 3) of the sheet folded as 12 over the front of the folded portion and sealed onto the opposite end 14 at 13 with silicone rubber sealant. Alternatively, the end could be welded, brazed or soldered, and also the ducts could be similarly closed by welding, brazing or soldering. Similarly, the loose end 11 (Figure 3) is shown in Figure 4 as folded 15 over the back of the heat exchanger and sealed at 16. In this way, two completely separate compartments are formed one at the back of the continuous folded sheet and the other at the front of the folded sheet. The compartment at the back is only open to the base of the heat exchanger, while the compartment at the front is only open to the top of the heat exchanger.

Figure 5 shows the bottom of the front face of the aluminium sheet 12 cut away at the base to form an opening 17 into the ducts on the front face of the folded aluminium sheet.

Similarly, the back face 15 is cut away at the top to form an opening 18 into the ducts on the back face of the sheet 1.

In use as domestic heating apparatus, hot flue

gases are drawn into the bottom of the heat exchanger 19, pass up through the channels on the back of the sheet where they are cooled by transferring heat through the sheet until they are expelled backwards at 20 out of the back/top of the heat exchanger. At the same time, fresh air is drawn into the top of the heat exchanger at 21 where it passes down the ducts, picking up the heat being recovered from the flue gases and transferred through the sheet, until the warm fresh air is blown out of the front of the base of the exchanger at 22 where it enters the dwelling house as warm fresh ventilation air.

Figure 6 shows a similar arrangement of a heat exchanger except that the top is completely closed off by plate 23 completely sealed to the top of the folded part of the sheet. Similarly, the bottom is completely sealed to a plate 24 placed on the bottom (or formed as part of the continuous sheet of aluminium and folded over the base and the top). The entry and exit points in this case are formed by cutting of the top and bottom of each face.

A further embodiment of the invention is illustrated in Figures 7 and 8. This is as a passive heat exchanger for incorporation into a heat pump type of ventilation heat recovery unit. In this application, the heat exchanger is situated such that the warm stale air being extracted from the ventilated space is passed through one of the sets of channels formed in the heat exchanger. The cold fresh air being drawn in from outside is passed through the other set of channels formed in the heat exchanger. Heat is transferred in the exchanger from the warm stale air into the cold fresh air such that the warm stale air is pre-cooled before it is passed to the evaporator of the heat pump, while the cold fresh air is pre-heated before it is passed to the condenser of the heat pump where it is further heated before it is passed into the ventilated space.

A particular application of the heat exchanger allows it to be used to take the warm stale air in at, for example, the top of the heat exchanger and expel it at the bottom on the opposite side of the exchanger, while the cold fresh air is also taken in at the top of the exchanger, on the opposite side from the warm stale air, and is expelled at the bottom of the exchanger again at the opposite side from the side on which the stale air is expelled. This application is illustrated in Figure 7 in which a tinned copper foil 25 is folded into a series of rectangular channels 26 and 27 and the two ends of the foil are folded back over the ends of the folds. End 28 of the foil is folded over the front of the heat exchanger at 29 while the other end 30 of the foil is folded over the back of the heat exchanger at 31. Before sealing these flaps onto the heat exchanger areas of the flaps are removed as shown by the dotted lines at 32 and 33 so as to provide openings into the channels at either side of the top of the heat exchanger. The flaps 28 and 30 are then sealed onto the front and back faces respectively of the heat exchanger by placing the whole heat exchanger into an oven to melt the solder and allow each point of overlap of the flap 28 with the exchanger to seal by melting the solder and allowing all points of overlap to fuse themselves together.

This results in the exchanger shown in Figure 8 with the areas of overiap, only, cut away on either side to provide exits from the ducts at the bottom as shown at 34, with corresponding double layer areas of foil cut away at the back of the heat exchanger. The top and bottom ends are sealed off by plates of tinned copper foil 35 and 36 which are placed on the top of and on the bottom of the heat exchanger and sealed, by melting the solder, to each fold of of the copper foil.

Modifications and improvements may be incorporated without departing from the scope of the invention.

CLAIMS

1. A method of producing a heat exchanger, comprising providing a corrugated sheet, forming the corrugations into passageways for fluid flow along the corrugations so that adjacent passageways have a common wall, providing a fluid inlet and a fluid outlet for the passageways, so that, in use, fluid flowing along each passageway is in heat-exchange communication through said common wall with fluid flowing along an adjacent passageway.

2. A method of producing a heat exchanger as claimed in Claim 1, including forming the passageways by each recess of the corrugated sheet being sealed at one end.

3. A method of producing a heat exchanger as claimed in either Claim 1 or 2, including at least partially closing the mouths of the recesses of the corrugated sheet by the juxtaposition of a sheet of material continucus with the corrugated sheet.

4. A heat exchanger when produced by the method of any of the preceding Claims.

5. A heat exchanger as claimed in Claim 4, wherein the sheet has a ribbed surface.

6. A heat exchanger as claimed in either Claim 4 or 5, wherein the sheet consists of a sandwich of a first and a second material.

7. A domestic heating system incorporating a heat exchanger as claimed in any one of Claims 4, 5 or 6, said heat exchanger being mounted on a hood situated above an external opening of a gas balanced flue such that flue gases at an elevated temperature rise from the flue to pass into one set of passageways of the heat exchanger for heat exchange with fresh air in anoher set of passageways of the heat exchanger, thereafter the fresh air being expelled into the area being heated.

8. A method of producing a heat exchanger substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

9. A heat exchanger substantially as hereinbefore decribed with reference to and as shown in the accompanying drawings.

10. A domestic heating system incorporating a heat exchanger substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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